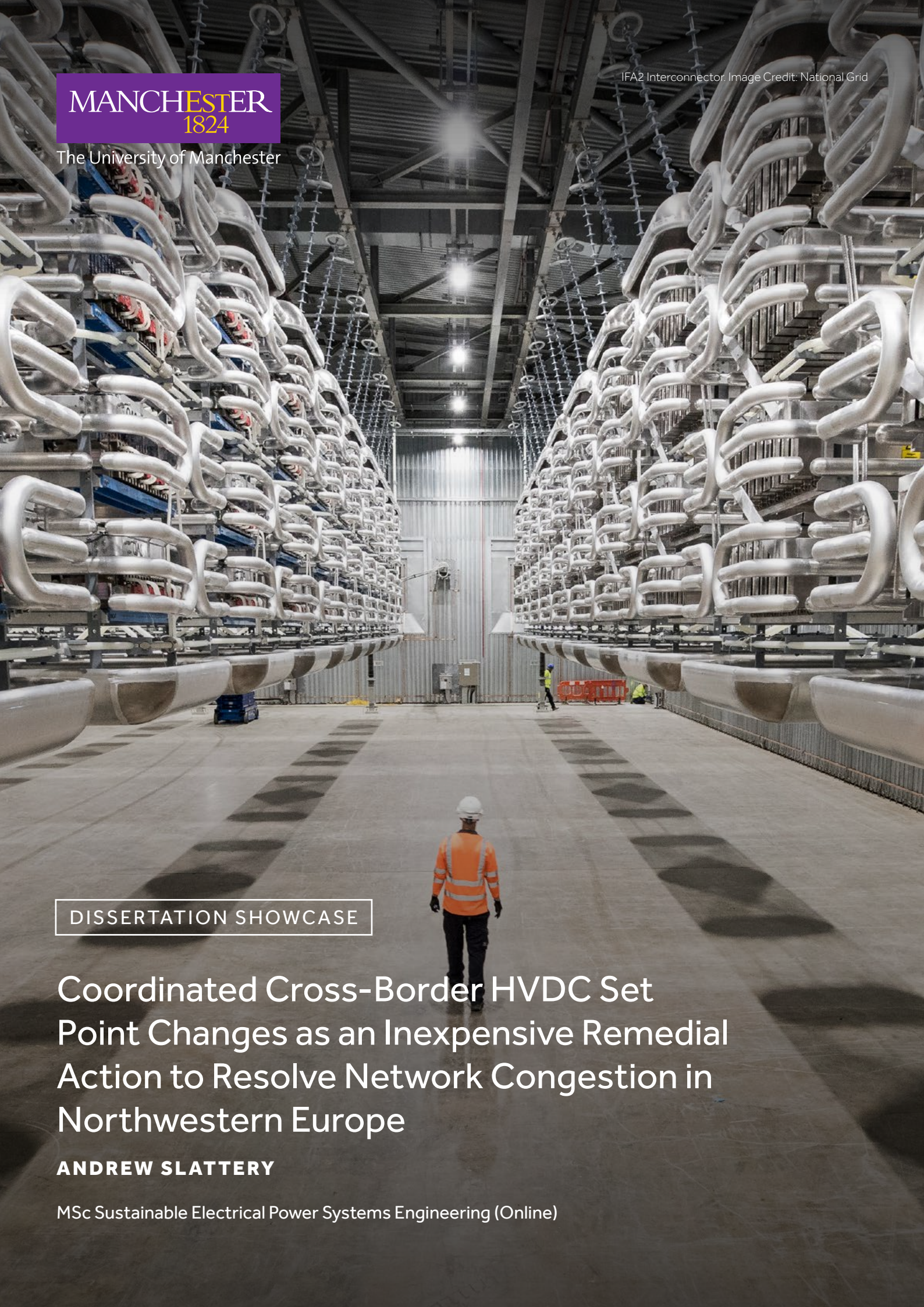

IFA2 Interconnector. Image Credit: National Grid

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DISSERTATION SHOWCASE

Coordinated Cross-Border HVDC Set Point Changes as an Inexpensive Remedial Action to Resolve Network Congestion in Northwestern Europe

ANDREW SLATTERY

MSc Sustainable Electrical Power Systems Engineering (Online)

DISSERTATION SHOWCASE

Coordinated Cross-Border HVDC Set Point Changes as an Inexpensive Remedial Action to Resolve Network Congestion in Northwestern Europe

ANDREW SLATTERY

Power System Engineer, NESO
Security and Coordination Engineer, Coreso

BACKGROUND

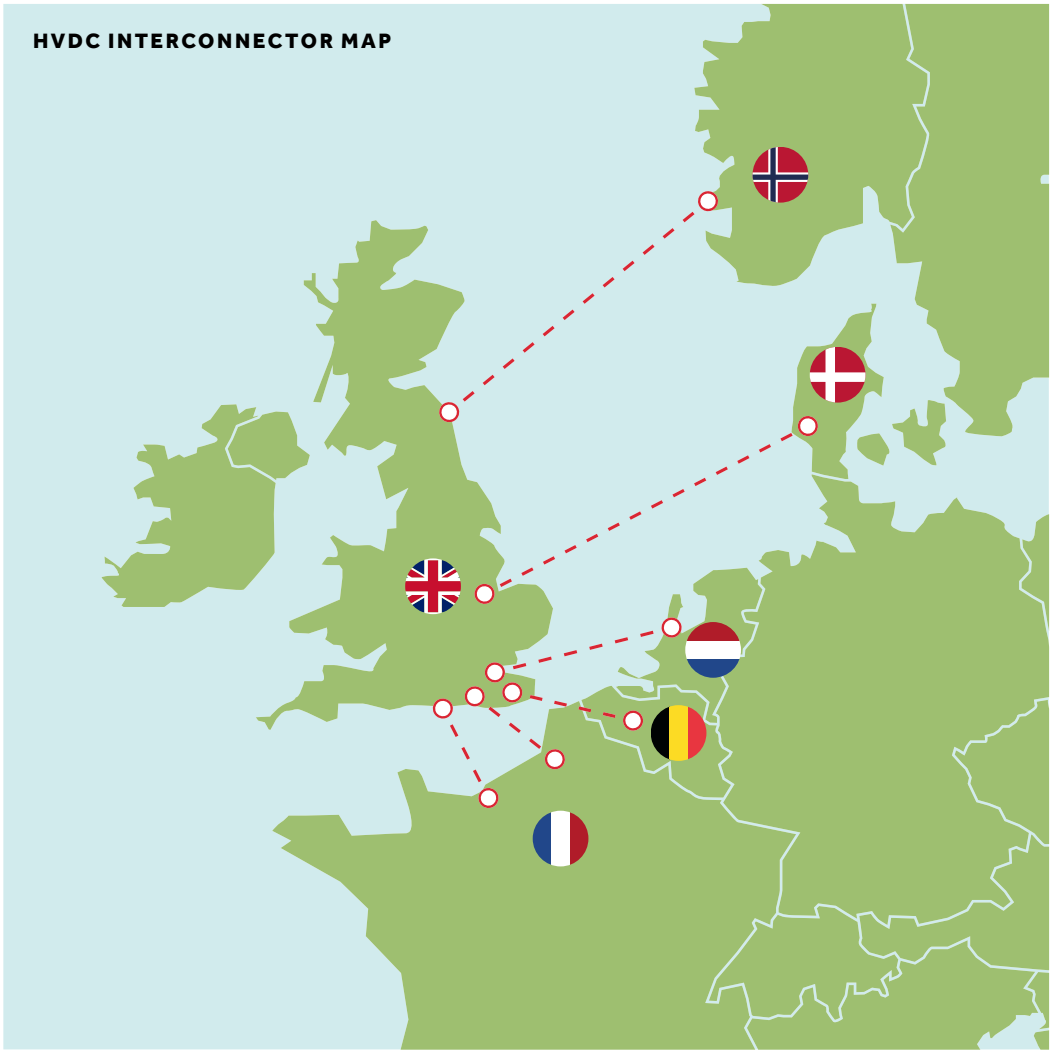
When choosing a dissertation topic for my MSc in electrical power systems engineering, I wanted to explore something meaningful and professionally relevant. My experience spans both UK and European power systems, starting in the control room at NESO (formerly National Grid ESO) and now at Coreso, a regional coordination centre in Brussels. This dual perspective gave me insight into the challenges of cross-border electricity flows and rising network congestion across Europe.

With more HVDC interconnectors being built and congestion costs increasing, I saw an opportunity to investigate whether coordinated HVDC set point changes, adjusting power flow on these cables in a balanced way, could offer a low-cost, technically sound solution. The idea originated from a senior colleague and aligned seamlessly with both academic goals and the company's strategic interests, making it a high-impact research opportunity.

PROJECT SUMMARY

My dissertation explored the use of coordinated set point changes in High Voltage Direct Current (HVDC) interconnectors to alleviate network congestion in Northwestern Europe. With seven HVDC links currently connecting Great Britain to Continental Europe and more planned. The study addressed a gap in existing research: the lack of analysis on coordinated HVDC actions between separate AC networks.

I conducted contingency analyses on seven historical case studies involving the AC grids of Belgium, France, the Netherlands, and the UK. In five cases, coordinated HVDC adjustments proved highly effective in mitigating congestion, offering a technically sound and financially promising solution. Estimated cost savings reached into the millions of pounds per application, though financial projections carried uncertainty due to necessary assumptions.



IFA 70KM
Connects to France with enough capacity to power 2 million homes.

BRITNED 260KM
Connects to the Netherlands with enough capacity to power 1 million homes.

NEMOLINK 140KM
Connects to Belgium with enough capacity to power 1 million homes.

NORTH SEA LINK 720KM
Connects to Norway with enough capacity to power 1.4 million homes.

VIKING 760KM
Connects to Denmark with enough capacity to power 1.4 million homes.

Expert interviews with grid operators validated the approach's potential, though practical implementation challenges remain, particularly around market structures and stakeholder alignment. Overall, the project contributes original insights to sustainable power systems by showing how existing infrastructure can be optimised to enhance grid efficiency and cross-border cooperation.

METHODOLOGY

I began with a literature review and quickly found a gap: while HVDC and congestion were well-covered separately, coordinated actions between AC networks were rarely addressed. This confirmed the relevance of my research.

I selected seven historical congestion cases and used load flow analysis tools to simulate how coordinated HVDC actions might have helped. I drew on real-world data from the NESO portal, ENTSO-E reports, and my own operational experience. Interviews with experienced system operators helped validate the practicality of the approach.

Collaboration was key, especially with a colleague who had over 20 years

of experience and supported the technical modelling. I also learned to use PowerFactory, a widely adopted industry tool, which has already proven valuable in my career.

Academic guidance was crucial, particularly for the literature review. Having been out of education for some time, I appreciated The University of Manchester's strong focus on teaching academic research skills. My advisor helped me structure my ideas and offered new perspectives I wouldn't have considered alone.

OFFSHORE NETWORK DEVELOPMENT PLANS (ONDPs)

The future European offshore transmission system will be a combination of radial offshore RES connections, classical point-to- point interconnections, offshore hybrid projects combining both functions and multi- purpose solutions integrating energy sectors

Hybrid corridors will progressively grow to link to up to 14% of offshore RES in 2050

> My advice to future students: start early and stay organised.' Planning tasks in advance and mapping out your schedule makes everything more manageable and keeps you accountable.

FINDINGS & IMPACT

The results were encouraging. In five of the seven case studies, coordinated HVDC actions effectively relieved congestion without costly redispatch or generation changes. Potential savings were in the millions per application, though I carefully noted the assumptions behind those estimates.

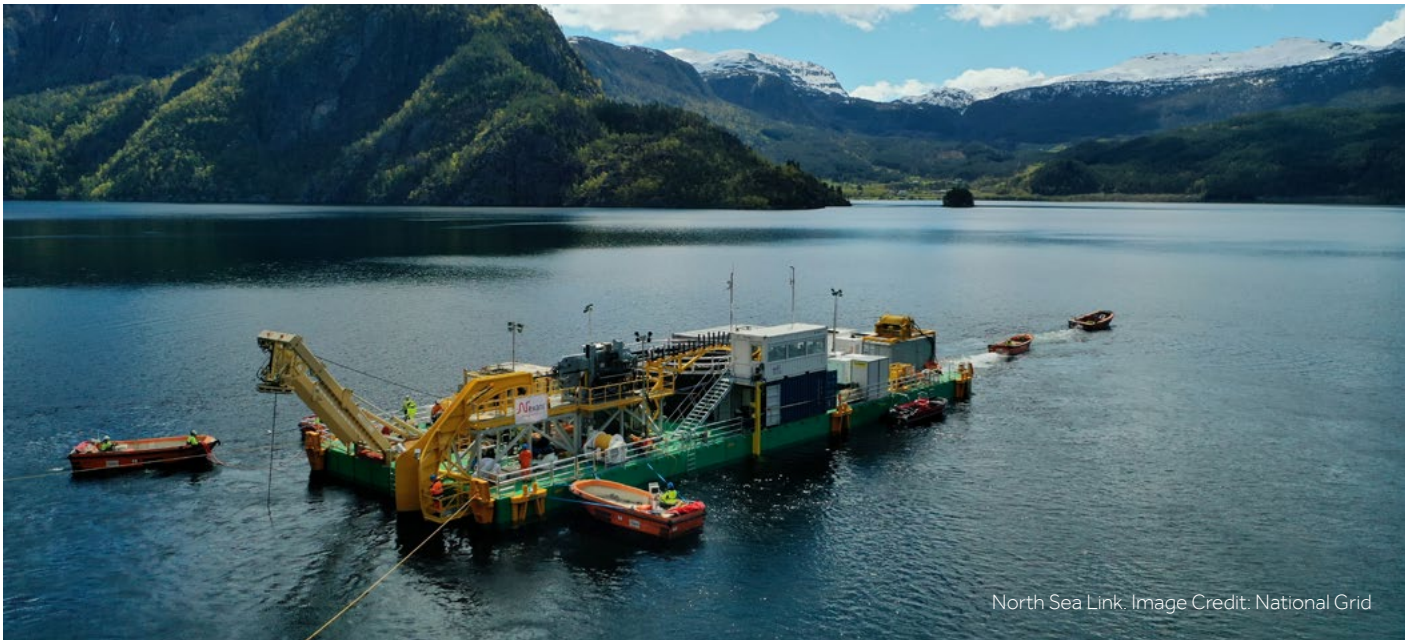
This approach could benefit multiple countries including Belgium, France, the Netherlands, and the UK by making better use of existing infrastructure. It's not a solution for everyday use, but under the right conditions, it could be transformative.

PERSONAL AND PROFESSIONAL GROWTH

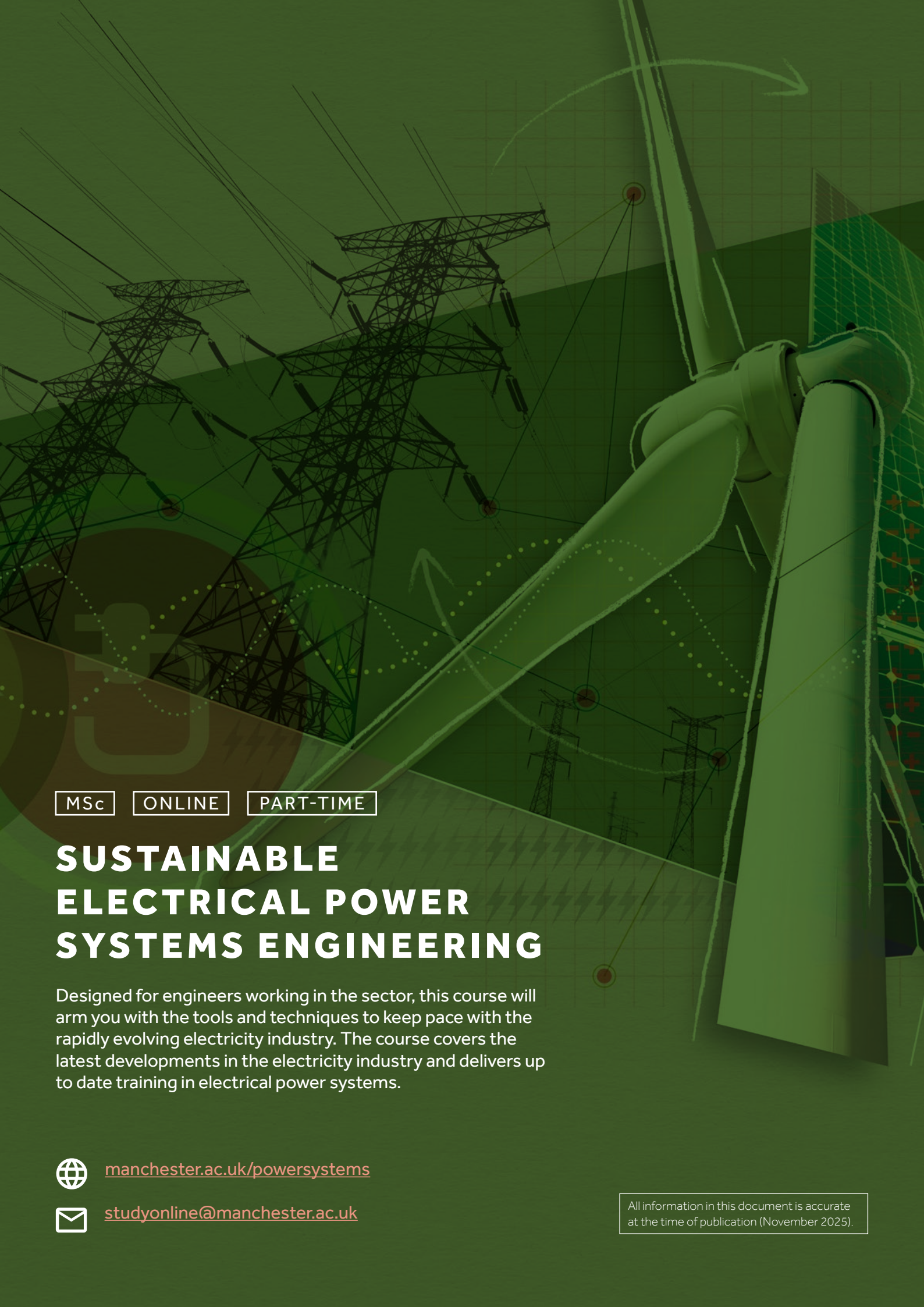
This experience has shaped my career goals by highlighting the importance of offshore coordination and interconnectivity in the energy sector. Exposure to future grid models for 2030 and 2040, especially hybrid interconnectors integrating wind farms, deepened my appreciation for the scale and complexity of sustainable energy infrastructure.

As these systems evolve, professionals will be needed to manage coordination, ensure efficient energy distribution, and navigate regulatory challenges. The project also revealed the dynamics between national operators and varying levels of commitment, sparking my interest in international energy collaboration and policy.

Through the dissertation, I built a strong foundation in research and critical analysis. I now feel confident tackling complex, exploratory tasks independently. One key skill I gained was evaluating sources critically—asking whether they genuinely advanced my understanding rather than confirming assumptions. This shift in mindset was a major development.



North Sea Link. Image Credit: National Grid



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All information in this document is accurate at the time of publication (November 2025).